REDUCING ENERGY CONSUMPTION IN HEALTHCARE BUILDINGS

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IFMA Healthcare Conference 2009

Air Side Drivers

- Human Metabolic Loads
- Lighting Loads
- Equipment Loads
- Minimum Ventilation Rates for Human Occupancy
- Corporate Minimum Air Exchange Rates
- Direct Exhaust Makeup

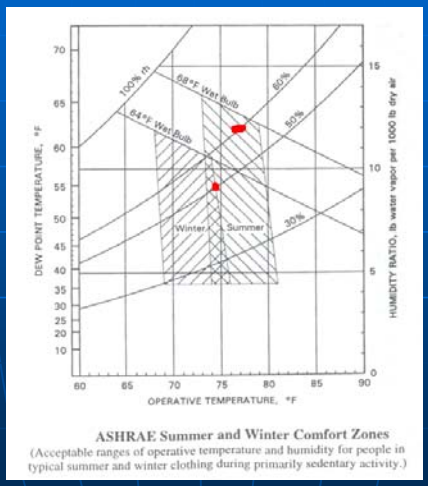
Historical Methods of Approach

- All Air
  - Constant Volume with Reheat
  - Variable Volume with Reheat
  - Multi-position with Reheat
- Makeup Air with Supplemental Heating/Cooling
  - Fan Coil Units
  - Finned Tube Radiation

Energy Conservation Approaches

- Comfort Envelope
- Central Approach
- “Local” Approach
- Air Flow Demand Control

New Comfort Envelope



ASHRAE Summer and Winter Comfort Zones
(Acceptable ranges of operative temperature and humidity for people in typical summer and winter clothing during primarily sedentary activity.)

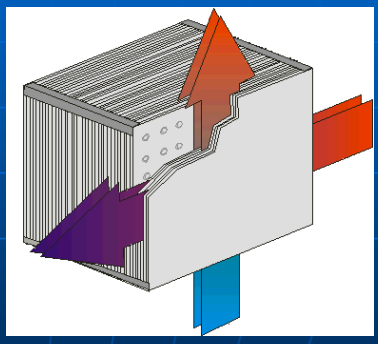
Savings = 150 Tons/100,000 CFM of Outdoor Air

Central Approach
Types of Air to Air Heat Exchangers

- **Fixed Plate**
- **Run Around Loops**
- **Heat Pipe**
- **Heat Wheels**

Central Approach
Fixed-Plate Heat Exchangers

- **Advantages**
  - No Moving Parts
  - Low Pressure Drop
- **Disadvantages**
  - Side by Side airstreams
  - Large Size at High Airflows
  - Sensible Recovery Only



Heat Pipes

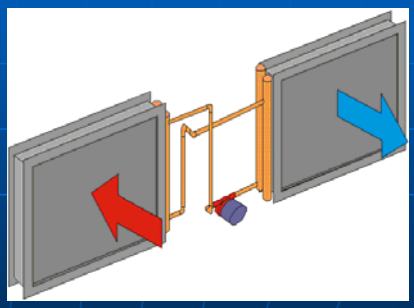
- Advantages
  - Simple/Passive
  - Lowest Maintenance
  - No Contamination Risk
- Disadvantages
  - Side by Side Airstreams
  - Orientation Critical
  - Sensible Only
  - Fan Location Critical

Energy Recovery Heat Pipe

Supply Air (cfm)	Exhaust Air (cfm)	Heat pipe Annual Energy Cost Savings ($/year)	Annual Fan Energy Penalty ($/year)	Total Energy Cost Savings ($/year)
25,000	25,000	$ 11,661	$ 2,176	$ 9,484
25,000	18,750	$ 8,745	$ 1,632	$ 7,113
25,000	12,500	$ 5,830	$ 1,088	$ 4,742
25,000	6,250	$ -	$ 544	$ (544)
Supply Air (cfm)	**Exhaust Air (cfm)**	**Heat pipe Annual Energy Cost Savings ($/year)**	**Annual Fan Energy Penalty ($/year)**	**Total Energy Cost Savings ($/year)**
15,000	15,000	$ 12,183	$ 1,920	$ 10,263
15,000	11,250	$ 9,137	$ 1,440	$ 7,697
15,000	7,500	$ 6,091	$ 960	$ 5,131
15,000	3,750	$ -	$ 480	$ (480)

Central Approach
Run Around Loop

- Advantages
  - No Cross Contamination Risk
  - Remote Airstreams
  - Fan Location Not Critical
- Disadvantages
  - Low Effectiveness
  - Sensible Recovery Only
  - Parasitic System Losses



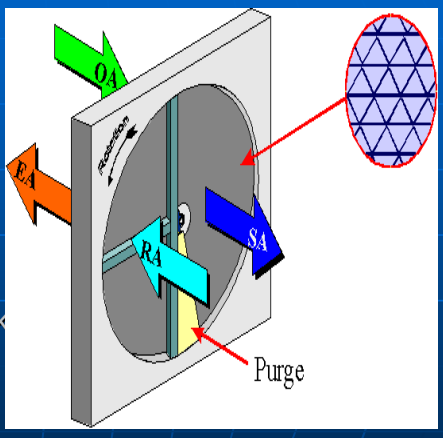
Energy Recovery Glycol Loop

Supply Air (cfm)	Exhaust Air (cfm)	Glycol loop Annual Energy Cost Savings ($/year)	Annual Fan Energy Penalty ($/year)	Total Energy Cost Savings ($/year)
25,000	25,000	$ 8,772	$ 2,176	$ 6,595
25,000	18,750	$ 6,579	$ 1,632	$ 4,947
25,000	12,500	$ 4,386	$ 1,088	$ 3,298
25,000	6,250	$ -	$ 544	$ (544)

Supply Air (cfm)	Exhaust Air (cfm)	Glycol loop Annual Energy Cost Savings ($/year)	Annual Fan Energy Penalty ($/year)	Total Energy Cost Savings ($/year)
15,000	15,000	$ 12,183	$ 1,920	$ 10,263
15,000	11,250	$ 9,137	$ 1,440	$ 7,697
15,000	7,500	$ 6,091	$ 960	$ 5,131
15,000	3,750	$ -	$ 480	$ (480)

Central Approach
Rotary Heat Wheel

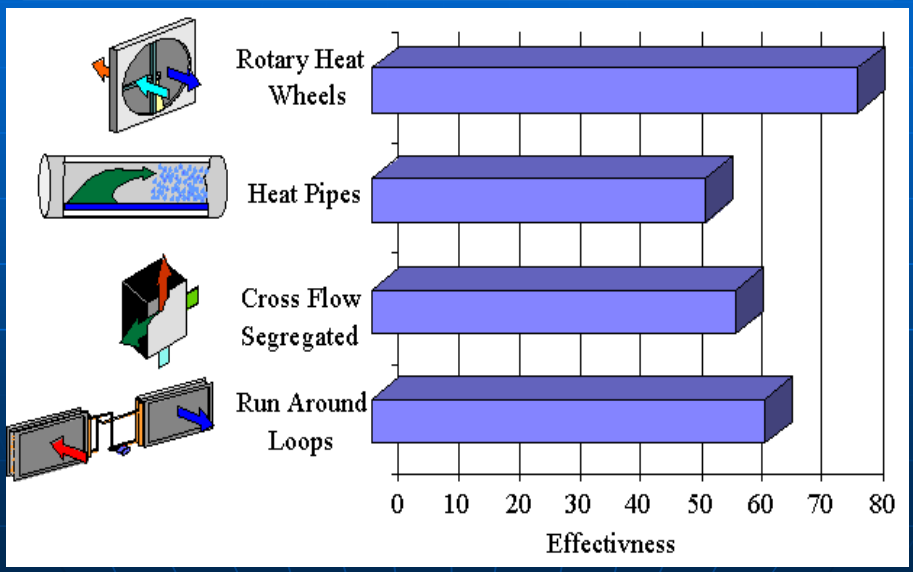
- Advantages
  - Moisture Transfer
  - Highest Effectiveness
  - Highest Energy Savings
- Disadvantages
  - Side by Side airstreams
  - Cross Contamination Risk
  - High Maintenance
  - Moving Parts
  - Purge
  - Fan Location Critical



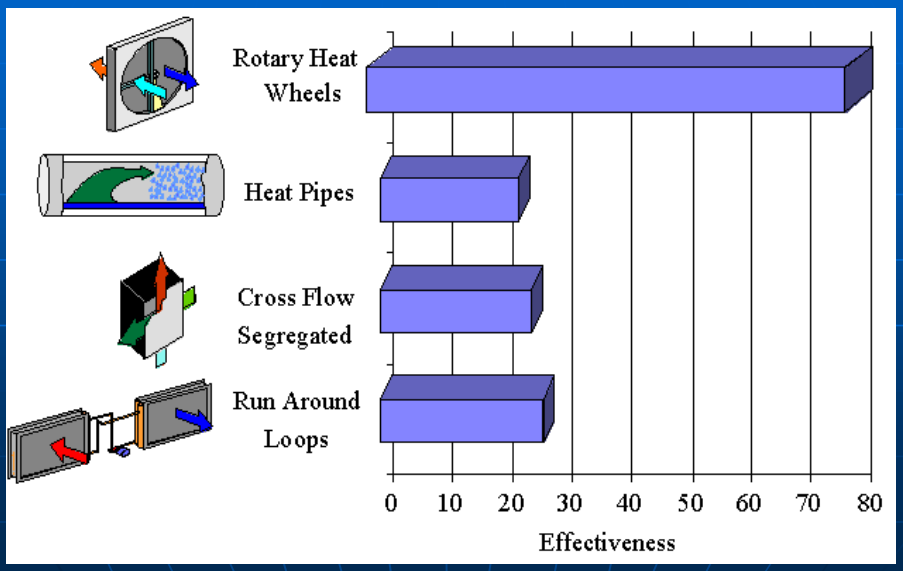
Energy Recovery Heat Wheel

Supply Air (cfm)	Exhaust Air (cfm)	Heat Wheel Annual Energy Cost Savings ($/year)	Annual Fan Energy Penalty ($/year)	Total Energy Cost Savings ($/year)
25,000	25,000	$ 40,215	$ 3,482	$ 36,733
25,000	18,750	$ 30,162	$ 2,612	$ 27,550
25,000	12,500	$ 20,108	$ 1,741	$ 18,367
25,000	6,250	$ 10,054	$ 871	$ 9,183
Supply Air (cfm)	**Exhaust Air (cfm)**	**Heat Wheel Annual Energy Cost Savings ($/year)**	**Annual Fan Energy Penalty ($/year)**	**Total Energy Cost Savings ($/year)**
15,000	15,000	$ 35,484	$ 3,072	$ 32,412
15,000	11,250	$ 26,613	$ 2,304	$ 24,309
15,000	7,500	$ 17,742	$ 1,536	$ 16,206
15,000	3,750	$ 8,871	$ 768	$ 8,103

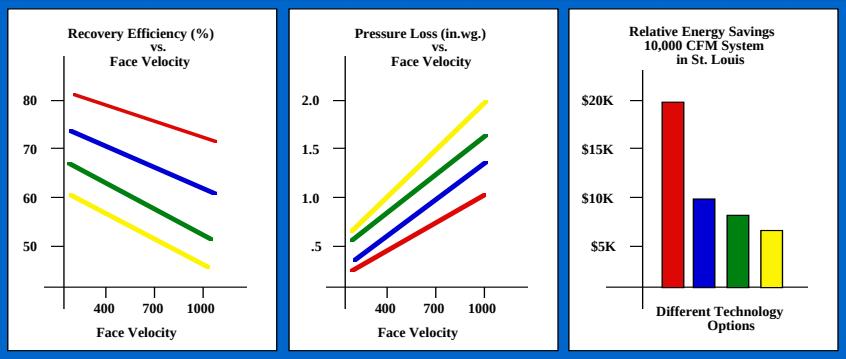
Central Approach
Sensible Energy Effectiveness



Central Approach
Total Energy Effectiveness



Central Approach
Device Comparisons



Total Energy Wheel

Heat Pipe

Plate Exchanger

Run Around Coils

Source: ASHRAE and SMACNA Design Guide

Central Approach
Cross Contamination

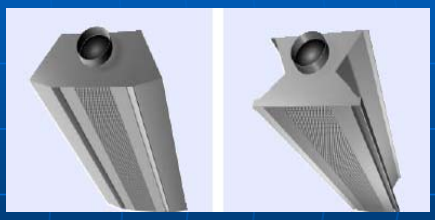
- Fixed Plate
  - Possible through plate defects
  - Possible with Moisture Permeable Membrane
- Run Around Loop
  - Not Possible
- Heat Pipe
  - Possible, thru tube sheet defects
- Heat Wheel
  - Guaranteed

Filtration Recommendations

- Filtration
  - Recommended upstream for all types of air to air heat recovery
  - 100% OA – MERV 11 (65%)
  - Return side – MERV 8 (30%)
- Surface Cleaning
  - Vacuum
  - Compressed air
  - Low temperature steam (consult manufacturer)
  - Hot water with detergent (consult manufacturer)
- Important on Heat Wheels to maintain proper seals

Local Approach
Chilled Beam

Passive Beam
by convection
and radiation



Active Beam
by Induction

What are Chilled Beams?

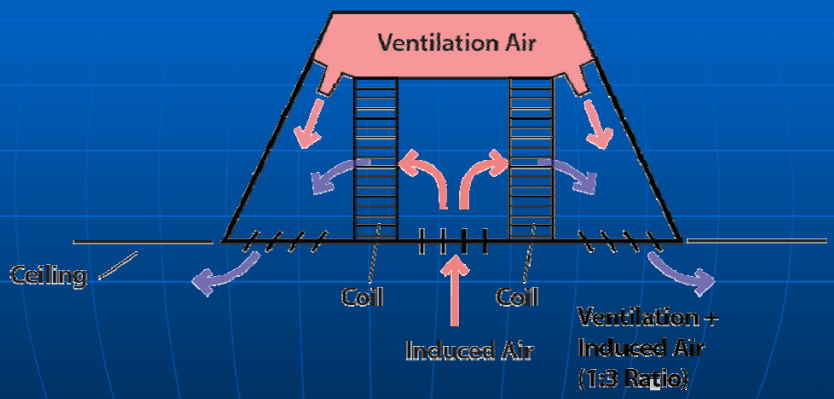
- A sensible cooling only device that uses chilled water temperatures above the room dewpoint temperature to remove heat from the space
- They can be independent of, or combined with, a method of introducing conditioned outside air to the space to meet ventilation requirements

Benefits of Chilled Beams

Smaller HVAC Systems:

- Reduced Space Needs
- Reduced Reheat
- Fan Energy vs. Pump Energy
- Building Energy Savings

Active Chilled Beam



Local Approach
Air Side Impact

System	OA CFM	Total CFM	Tonnage	Air HP
Conventional VAV	110,000	325,000	1,100	600
Fan Coils	110,000	460,000	1,100	300
Chilled Beams	110,000	130,000	900	190

Sphere of Influence for 250,000 SF

When to use a Chilled Beam

Space	O.A. ACH	T.A. ACH
Patient	2	6
Patient Corridor	2	4
Physical Therapy	2	6
Waiting Admitting	2	6
Medication	2	4
X-ray*	2	6

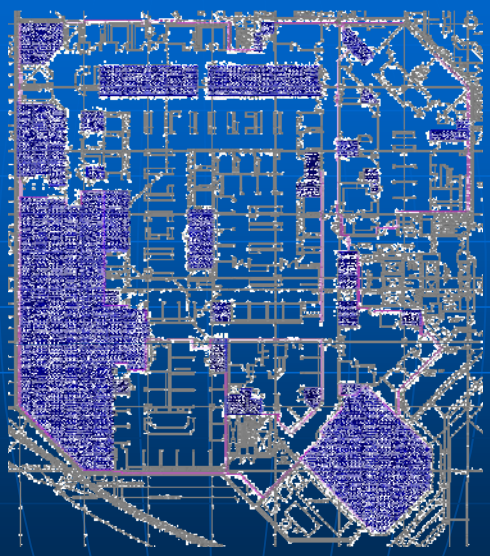
*Chilled Beam application in X-Ray is contingent upon the definition of space use

When not to use a Chilled Beam

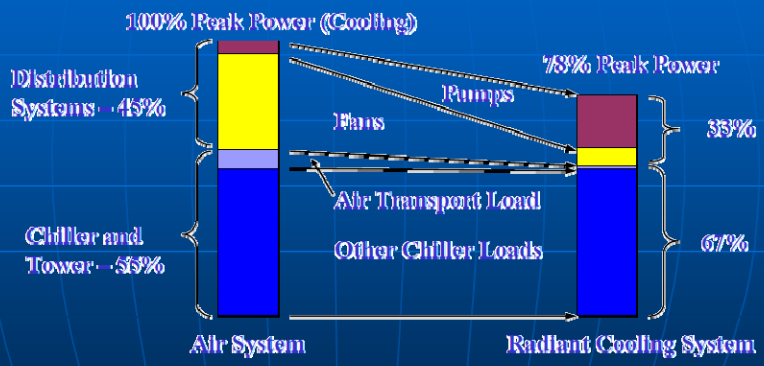
- Isolation Rooms
- Trauma / Operating Rooms
- Soiled Holding
- Crisis Intervention Unit

(Recirculation of room air is prohibited by AIA Guidelines)

Overview



Power Demand of All Air System vs. Chilled Beam System



THANK YOU

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